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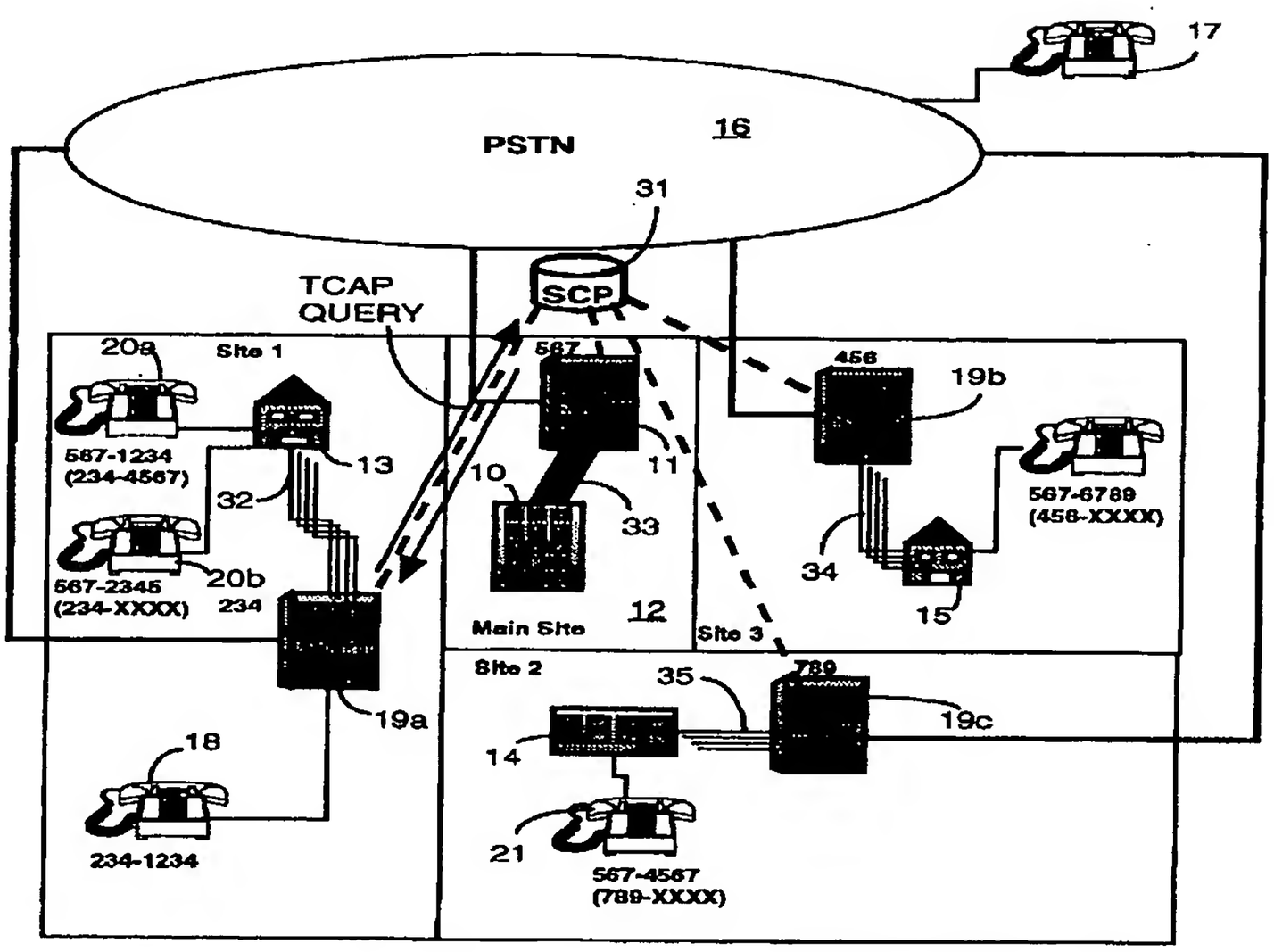
(54) **CENTREX LONGUE DISTANCE VIRTUEL**
(54) **VIRTUAL WIDE AREA CENTREX**



(57) Méthode et système permettant de fournir des services centrex longue portée à un réseau téléphonique ayant un certain nombre de centres de commutation dotés de SPP (points de commutation de services) utilisant un logiciel d'application AIN (réseau intelligent de pointe). Le réseau a un central serveur offrant la fonctionnalité centrex à un certain nombre de sites clients servis respectivement par des centraux distincts. Un numéro de téléphone virtuel est affecté à chaque station utilisé aux sites clients. Chaque central est relié à un point de commande de services (SCP) comportant une base de données de traduction de numéros contenant des affectations de numéros virtuels. Un numéro virtuel composé est traduit en un numéro réel afin de déterminer comment acheminer un appel vers n'importe quel des sites clients recevant des services de type centrex et le numéro réel d'une station appelante est ensuite traduit en un numéro virtuel pour que les fonctions de type centrex puissent être maintenues à chaque site client.

(57) A method and system is disclosed for providing wide area centrex services to a telephone network having a number of telephone switching offices equipped with SSPs (Service Switching Points) operating with AIN (Advanced Intelligent Network) application software. The network has a serving central office for providing centrex functionality to a number of customer sites, each served by separate central offices. A virtual telephone number is assigned to each station used at the customer sites. Each central office is connected to a service control point (SCP) having a number translation database containing the virtual number assignment. A dialed virtual number is translated to a real number to determine how to route a call to any one of the customer sites served with centrex type services and the real number of a calling station is then translated to a virtual number such that centrex type features can be maintained at each customer site.

Abstract

A method and system is disclosed for providing wide area centrex services to a telephone network having a number of telephone switching offices equipped with SSPs (Service Switching Points) operating with AIN (Advanced Intelligent Network) application software. The network has a serving central office for providing centrex functionality to a number of customer sites, each served by separate central offices. A virtual telephone number is assigned to each station used at the customer sites. Each central office is connected to a service control point (SCP) having a number translation database containing the virtual number assignment. A dialed virtual number is translated to a real number to determine how to route a call to any one of the customer sites served with centrex type services and the real number of a calling station is then translated to a virtual number such that centrex type features can be maintained at each customer site.

Virtual Wide Area Centrex

Summary of the invention

This invention relates to telecommunications Intelligent Network call routing via SS7 signaling from a network of switches, but more particularly to a method of providing an improved wide area centrex service.

Background of the invention

Centrex Service is a widely-deployed generic business offering which provides customers with features that are normally associated with PBXs (Private Branch Exchange). Whereas a PBX is located on the customer's premise, Wide Area Centrex type of services are provided via the telephone companies CO (Central Office) premises. Therefore, the services offered by Centrex capable central offices are shared with the PSTN (Public Switched Telephone Network) and with other business customers. Customers having several service centers or locations within an Exchange, but which are distributed among several central office serving areas, i.e. with different NXXs, are customarily served at all locations from a single central office, for example, the CO that serves the main site. The remaining sites are then served by digital remote concentrators that are homed on the main CO. This arrangement allows all the customer's locations to be served by a single NXX, which becomes, in effect, a private Numbering Plan that can be administered by the customer. Although most of the fundamental business needs are met, this solution is costly to deploy, inefficient, and not available to locations with small numbers of lines. This can be an irritant for customers with a large main office and many small branches within a city.

A need therefore exist for providing a centrex type service which reduces the above shortcomings.

It is therefore an object of the present invention to provide a wide area centrex wherein the NXX associated with the customer's number is translated into a virtual (typically 4-digit) Private Numbering Plan, with total separation of the virtual and real numbers.

Another object of the present invention is to provide virtual wide area centrex services which make use of an SCP to translate virtual to real telephone numbers of stations served by centrex type services.

In accordance with an embodiment of the present invention, there is provided a method of providing wide area centrex services to a telephone network having a number of telephone switching offices equipped with SSPs (Service Switching Points) operating with AIN (Advanced Intelligent Network) application software, the network having a serving central office for providing centrex functionality to a number of customer sites, each served by separate central offices, comprising the steps of:

assigning a virtual telephone number to each station used at the customer sites;

connecting each central office to a service control point (SCP), the SCP having a number translation database containing the virtual number assignment;

translating a dialed virtual number to a real number to determine how to route a call to any one of the customer sites served with centrex type services; and

translating the real number of a calling station to a virtual number such that centrex type features can be maintained at each customer site.

In accordance with another embodiment of the present invention, there is provided a telephone network for providing wide area centrex services, having a number of telephone switching offices equipped with SSPs (Service Switching Points) operating with AIN (Advanced Intelligent Network) application software, the network

having a switching office for providing centrex functionality to a number of customer sites, each served by separate switching offices, comprising:

a service control point (SCP) connected to each switching office and having a number translation database containing virtual numbers that have been assigned to each telephone device used at the customer sites;

each SSP of a customer site being adapted to receive a number of digits sent from a calling station;

means for identifying, at the SSP, an access code from the received digits using the SSP's IN trigger;

means for formulating an SS7 message appropriate to the IN trigger used;

means for transmitting the SS7 message from the SSP to the SCP via a CCS (Common Channel Signaling) transport facility;

means for pre-translating at the SCP the received SS7 message to determine a routing number to route the call to any one of the customer sites served with centrex type services;

means for formulating another SS7 message at the SCP containing the routing number;

means for transmitting the formulated SS7 message to the SSP of the customer site to instruct the telephone network how the complete the call; and

means for translating the real number of the calling station to a virtual number such that centrex type features can be maintained at each customer site.

Brief description of the drawings

The invention will be better understood by an examination of the following description, together with the accompanying drawings, in which:

Figure 1 is a block diagram of the main elements forming part of a prior art telephone network offering wide area centrex;

Figure 2 is a block diagram of the main elements forming part of a telephone network offering virtual wide area centrex according to the present invention;

Figure 3 is a flow chart illustrating a trigger detection routine; and

Figures. 4a and 4b are translation tables for use with the network of the present invention.

Description of the preferred embodiments

The network shown in the Figures 1 and 2 do not show, for sake of clarity, all elements normally associated with SS7 messages. A typical SS7 network consist of signaling links and nodes. SS7 nodes are referred to as signaling points (SP) and are interconnected by signaling links. Each SP is assigned a unique point code, serving as the network address for message routing. SS7 signaling points (SP) include Services Signaling Points (SSP), Service Control Points (SCP), and Signal Transfer Points (STP).

Services Signaling Points (SSP) are generally associated with SS7 equipped switching offices. Their prime function is to serve as a source and destination for messages related to the calls it handles. Incoming messages are formatted and transferred to the relevant processing function in the switch. Outgoing messages are transmitted over the signaling links.

Service Control Points (SCP) is often referred to as the SS7 services data base. One or more SCPs can serve as a central intelligence point in the network for determining how and if calls are to be routed through the network. Queries and responses to and from the SCP are carried over SS7 signaling links in the form of packet messages, each containing the source and destination address.

Signal Transfer Points (STP) are special signaling point nodes which provide a message switching function between other nodes in a SS7 network. Acting as a packet switch, it examines incoming messages and then routes them over the appropriate signaling link to the proper destination switching offices and data bases. In this particular function, it supports end-to-end signaling, i.e. in transit (local, tandem and toll) connections, required for transaction messaging used for special services. Unlike other SS7 nodes, the STP does not generally act as a source or sink for SS7 messages. Positioned as a focal point in the SS7 network, the STP serves to concentrate, and thereby, reduce the number of required signaling links. For interconnections with other networks, the STP provides a formal SS7 interface point, and message screening to prevent unauthorized access to the network.

Referring now to Figure 1, we have shown a prior art telephone network offering wide area centrex to a number of remote customer sites.

As indicated previously, whereas a PBX is located on the customer's premise, Wide Area Centrex type services are provided via the telephone companies CO (Central Office) premises. Therefore, the services offered by Centrex capable central offices are shared with the PSTN (Public Switched Telephone Network) and with other business customers. When customers have several locations within an Exchange, but which are distributed among several central office serving areas, i.e. with different NXXs, it is customary to serve all the locations from a single central office, for example, the CO that serves the main site. The remaining sites are then served by digital remote concentrators that are homed on the main CO.

For example, in Figure 1, the main site 10 of a centrex user is served by a central office 11 which provides centrex functionality to other sites, remotely

located away from the serving area 12 of central office 11. In Figure 1, the other sites are depicted at reference numeral 13 for site 1, 14 for site 2 and 15 for site 3. All central offices are connected to the PSTN 16 and all sites in this example are located within the same exchange. That is, all sites can be reached without the need for toll offices. It is to be noted that although each site forms part of the PSTN 16, they are shown separately to illustrate the concepts of wide area centrex. That is, each switching office 19a, 19b and 19c are used for non-centrex users and thus each is shown connected to the PSTN 16. It should be noted that the centrex customers at location 13, 14 and 15 are all served by central office switch 11 via remote line peripherals, i.e. such as concentrators 22a, 22b and 22c. Note that the concentrators would actually be physically located with switching offices 19a, 19b and 19c respectively.

With existing wide area centrex services, each site which are located within the same exchange, can be reached using the same NXX numbering plan. That is, incoming calls from the PSTN, such as from calling station 17, which are directed to a centrex serviced telephone could be routed using the same NXX. For example, station 17 would be able to reach any site using the NXX 567, even though the remote sites are located in areas served by central offices with different NXXs. That is, telephone stations in site 1 are assigned telephone numbers with an NXX of 234, site 2 with an NXX of 789, site 3 with an NXX of 456 and the main site with an NXX of 567.

For non-centrex calls, a caller at station 17 who wishes to reach station 18 served by switching office 19a from the public switched telephone network (PSTN) 16 would dial 234-XXXX. Any call to a station with an NXX of 234 would be routed the same way. Similarly, calls to stations having an NXX of 789 and 456 will be routed via

switching offices 19c and 19b, respectively. On the other hand, a caller at station 17 wishing to reach station 20a of the centrex customer located at site 1, would dial the centrex customer's published number, i.e. 567-1234 even though the actual physical address of station 20a is 234-XXXX. When the call is made, the 567-1234 digits would be received at central office 11, which is the main centrex service site. Central office 11 would determine from the last four (4) digits that the called station is located on site 1. The call would then be routed via concentrator 22a to station 20a.

When a caller at station 20a wishes to reach another centrex station, the caller can simply dial the extension number or last 4 digits of the private numbering plan to complete the call. If an escape code, such as digit 9, is dialed, the call is treated as a normal call through the PSTN, but via central office 11 and not switching office 19a. If no escape code is used, then the call becomes a centrex type call, wherein the 4 digits are used to route the call. In this example, if a caller at station 20a wishes to reach station 21 of site 2, digits 3456 would be dialed at station 20a. The digits would be received by central office 11 via concentrator 22a and the call routed to station 21 via concentrator 22c. Even if a caller at station 20a wishes to call a station located on the same location, for example, station 20b, the call would still be routed via concentrator 22a to switch 11 and back again to station 20b.

Thus, this arrangement allows all the customer's locations to be served by a single NXX, which becomes, in effect, a private Numbering Plan that can be administered by the customer. As can be seen, although most of the fundamental business needs are met, this solution is costly to deploy, inefficient, and not available to locations with small numbers of lines. Thus, it is an irritant for customers with a large main

office and many small branches within a city. For example if a remote site has 20 lines required for centrex services, a concentrator with a capacity for 150 lines is in most instances the minimum that can be offered. The centrex customer is thus paying for a system which has a much higher capacity than is required.

Referring now to Figure 2, we have shown a block diagram illustrating the network elements required to provide a virtual wide area centrex according to the present invention. As in Figure 1, the customer requires a wide area centrex service between a main site 30 and three remotely located sites, i.e.. sites 1, 2 and 3. However, with the network of the present invention, the telephone numbers associated with a customer's centrex service are assigned a virtual (typically 4-digit) Private Numbering Plan, with total separation of the virtual and real numbers. The translation from virtual to real, and vice-versa, takes place at a service control point(SCP) 31, allowing remote locations to be served from any central office capable of launching SS7 messages to the SCP. Costly remote concentrators can then be removed or re homed; small locations, not previously accessible, can then be served cost-effectively on ordinary lines from their nearest CO. As indicated above, not all SS7 network elements are shown for sake of clarity. For example, although direct links (dashed lines) are shown from the central offices of each site to the SCP 31, the links could also be accomplished via Service Transfer Points (STP).

To avoid number changes and service disruption, the virtual numbers are initially made identical to the original real numbers. Then, as moves and changes take place within the private network (virtual numbers being portable within the private network), and remote locations have their real numbers converted to those of their nearest COs, the one-to-one equivalency between virtual and real numbers disappears, without adverse

consequences. A number translation matrix for use with the present invention is disclosed in applicant's co-pending patent application Serial No. 2,147,776, filed 25 April 1995. Per conventional IN practice, lines 32-35 within the Wide Area Centrex network are assigned a special BGID (Business Group ID) at each serving CO switch.

In operation, when a call is originated from one of these lines, say, calling station 20 and the dialed digits are not preceded by an "escape code" (e.g., the digit 9), and they apply to the internal network, an "assigned" trigger (customized dialing plan) is activated. Triggers can be either "assigned" or "office". With an "assigned" trigger, only lines that are assigned encounter the trigger.

As shown in Figure 3, at a point in call 40, as the call progresses through the trigger check point 41, the criteria 42 for that trigger is checked. The criteria 42, which can be established by a service order data fill, can include a specific line, trunk, dialed number, etc. If a match is found for the criteria, the query is sent 43 to the SCP. If no match is found, the call continues to progress until another check point is encountered. As in this example, the assigned trigger is a particular number, and if the dialed number matches the number assigned in the trigger, a query will be automatically sent to the SCP 31.

Referring again to Figure 2, if the number dialed by calling station 20 matches a predetermined trigger, the switch 19 then compiles a message and sends it to the SCP 31. There, the trigger type and BGID are pre-translated to determine the appropriate 4-digit PNP (Private Numbering Plan) (see Number Translation Matrix application). A database look-up is then performed in this PNP to obtain the real network terminating number, see Figure 4a.

In order to work properly, terminating features such as Caller ID, Call Return, and voice messaging must capture telephone numbers which, when returned, will reach the original calling party. This means that if a call is received from a caller with a virtual number, then it is the virtual number that must be captured and not the traditional equipment-based Calling Line ID. In this example, the calling station 20 has a virtual number of 567-1234 and a real number of 234-1234. Accordingly, a second look-up is made on a companion CPNP (Criss-Cross PNP), Figure 4b, to translate the calling station's real number into a virtual number so that destination features that need the caller's identity will work properly. During this second look-up, the CPNP can also supply the caller's name, if required by the service. In order to achieve this translation, the current CLID field used in AIN would have to be modified. A ten-digit Global Title Translation (GTT) at an STP for virtual-to-real destination point code digit translation can be used. With this option the CLID field would be substituted with the converted CLID data field. The information from both look-ups is then fed back to the originating switch and used to complete the call.

When a caller at station 17, located outside the Wide Area Centrex network, dials the private network's virtual NXX of station 20, i.e. 567-1234: At the PSTN switch serving the originating line (not shown)(or at the incoming PSTN switch serving a trunk from another PSTN area), all relevant virtual NXXs in the destination area are datafilled in the appropriate IN trigger table (see Figure 3). This data takes the form of 3 or 6-digit prefixes—"Access Codes" in IN parlance. An Access Code might point to a Numbering Plan related to a virtual POTS service, to Foreign Exchanges, or to a Wide Area Centrex network. This knowledge is not available to the switch, whose functions is intended to be service-independent. Instead, all calls to virtual

NXXs activate an "office" IN trigger (public office dialing plan) in the switch, associated with calling station 17, resulting in an SS7 message (such as TCAP) being compiled and forwarded to the SCP 31 for number translation. At the SCP, the NTS Matrix recognizes the trigger type and uses the Access Code as the "service key" to identify the appropriate Numbering Plan. In the case of Centrex, this is always the same PNP as that accessed from within the private network through the aforementioned BGID. Thus, in this example, pre-translation of the BGID and of the Access Code yield an equivalent translated number. If the caller's identity is necessary, a second look-up is made on the companion CPNP (Criss-Cross PNP), Figure 4b, to translate the calling station's real number into a virtual number so that destination features that need the caller's identity will work properly. As above, the information from both look-ups is then fed back to the originating switch associated with calling station 17 and used to complete the call to called station 20 having real number 234-1234.

Variations of the particular embodiment herewith described will be obvious to one skilled in the art, and accordingly the embodiment is to be taken as illustrative rather than limitive, the true scope of the invention being set out in the appended claims.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A method of providing wide area centrex services to a telephone network having a number of telephone switching offices equipped with SSPs (Service Switching Points) operating with AIN (Advanced Intelligent Network) application software, said network having a serving central office for providing centrex functionality to a number of customer sites, each served by separate central offices, comprising the steps of:

assigning a virtual telephone number to each station used at the customer sites;

connecting each central office to a service control point (SCP), said SCP having a number translation database containing said virtual number assignment;

translating a dialed virtual number to a real number to determine how to route a call to any one of said customer sites served with centrex type services; and

translating the real number of a calling station to a virtual number such that centrex type features can be maintained at each customer site.

2. A method as defined in claim 1, wherein incoming calls with virtual numbers are routed to any one of said stations of a customer site, by:

receiving at an SSP of a first customer site a call having a number of digits sent from a calling station;

identifying an access code from the received digits using the SSP's IN trigger;

formulating an SS7 message appropriate to the IN trigger used;

transmitting the SS7 message from the SSP of the first customer site to the remotely located SCP via a CCS (Common Channel Signaling) transport facility;

pre-translating at the SCP the received SS7 message to determine how to route the call to any one of said customer sites served with centrex type services; and

formulating another SS7 message at the SCP containing the routing number.

3. A method as defined in claim 1, wherein a centrex type call from a telephone device of a first customer site to a station of a second customer site is routed by:

receiving at the SSP of the first customer site the digits sent from the calling station;

determining if the digits sent from the calling station is a centrex type call or a public switched telephone network (PSTN) type call;

if the digits sent are indicative of a centrex call, identifying an access code from the received digits using the SSP's IN trigger;

formulating an SS7 message appropriate to the IN trigger used;

transmitting the SS7 message from the SSP of the first customer site to the remotely located SCP via a CCS (Common Channel Signaling) transport facility;

pre-translating at the SCP the received SS7 message to determine how to route the call to any one of said customer sites served with centrex type services; and

formulating another SS7 message at the SCP containing the routing number.

4. A method as defined in claim 3, wherein calls are determined to be directed to the PSTN if the dialed digits are preceded by an escape code.

5. A method of providing wide area centrex services to a telephone network having a number of telephone switching offices equipped with SSPs (Service Switching Points) operating with AIN (Advanced Intelligent Network) application software, said network having a serving central office for providing centrex functionality to a number of customer sites, each served by separate central offices, comprising the steps of:

assigning a virtual telephone number to each telephone device used at the customer sites;

connecting each central office to a service control point (SCP), said SCP having a number translation database containing said virtual number assignment;

receiving at an SSP of a first customer site a call having a number of digits sent from a calling station;

identifying an access code from the received digits using the SSP's IN trigger;

formulating an SS7 message appropriate to the IN trigger used;

transmitting the SS7 message from the SSP of the first customer site to the remotely located SCP via a CCS (Common Channel Signaling) transport facility;

pre-translating at the SCP the received SS7 message to determine how to route the call to any one of said customer sites served with centrex type services;

formulating another SS7 message at the SCP containing the routing number;

transmitting the formulated SS7 message to the SSP of the first customer site to instruct the telephone network how to complete the call; and

translating a real number associated with said calling station to a virtual number such that centrex type features can be maintained at each customer site.

6. A method as defined in claim 5, further comprising the steps of determining if the digits sent from the calling station are indicative of a centrex type call or a public switched telephone network (PSTN) type call; and

if the digits sent are indicative of a centrex call, identifying an access code from the received digits using the SSP's IN trigger.

7. A method as defined in claim 6, wherein calls are determined to be directed to the PSTN if the dialed digits are preceded by an escape code.

8. A telephone network for providing wide area centrex services, having a number of telephone switching offices equipped with SSPs (Service Switching Points) operating with AIN (Advanced Intelligent Network) application software, said network having a switching office for providing centrex functionality to a number of customer sites, each served by separate switching offices, comprising:

a service control point (SCP) connected to each switching office and having a number translation database containing virtual numbers that have been assigned to each telephone device used at the customer sites;

each SSP of a customer site being adapted to receive a number of digits sent from a calling station;

means for identifying, at the SSP, an access code from the received digits using the SSP's IN trigger;

means for formulating an SS7 message appropriate to the IN trigger used;

means for transmitting the SS7 message from the SSP to the SCP via a CCS (Common Channel Signaling) transport facility;

means for pre-translating at the SCP the received SS7 message to determine a routing number to route the call to any one of said customer sites served with centrex type services;

means for formulating another SS7 message at the SCP containing the routing number;

means for transmitting the formulated SS7 message to the SSP of the customer site to instruct the telephone network how to complete the call; and

means for translating a real number associated with said calling station to a virtual number such that centrex type features can be maintained at each customer site.

9. A network as defined in claim 8, further comprising means for determining if the digits sent from

the calling station are indicative of a centrex type call or a public switched telephone network (PSTN) type call; and

means for identifying an access code from the received digits using the SSP's IN trigger, if the digits sent are indicative of a centrex call.

10. A network as defined in claim 9, wherein said means for determining if the digits sent from the calling station are indicative of a centrex type call or a public switched telephone network (PSTN) type call is comprised of an escape code preceding the dialed digits.

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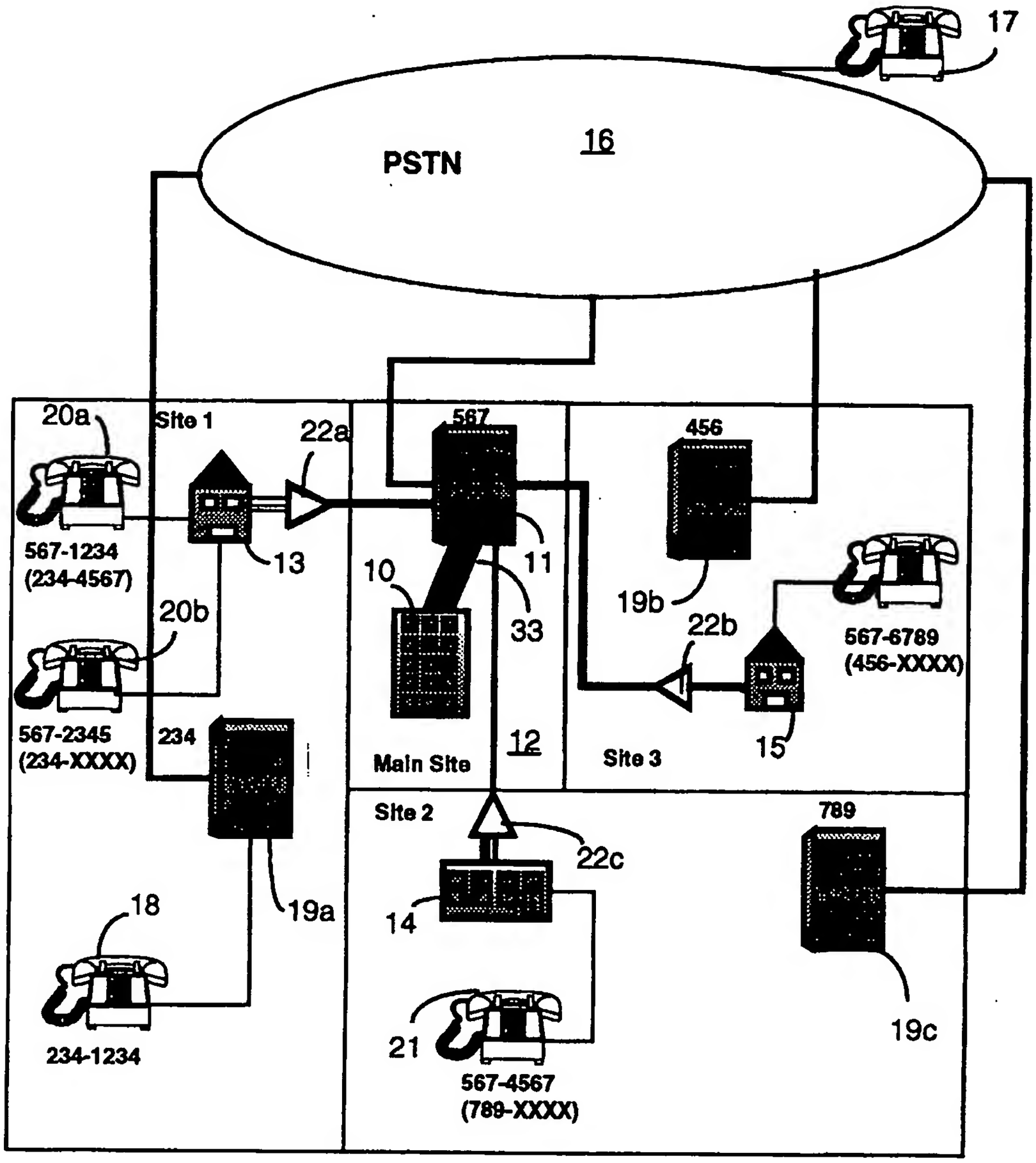

Fig. 1 **Prior art**

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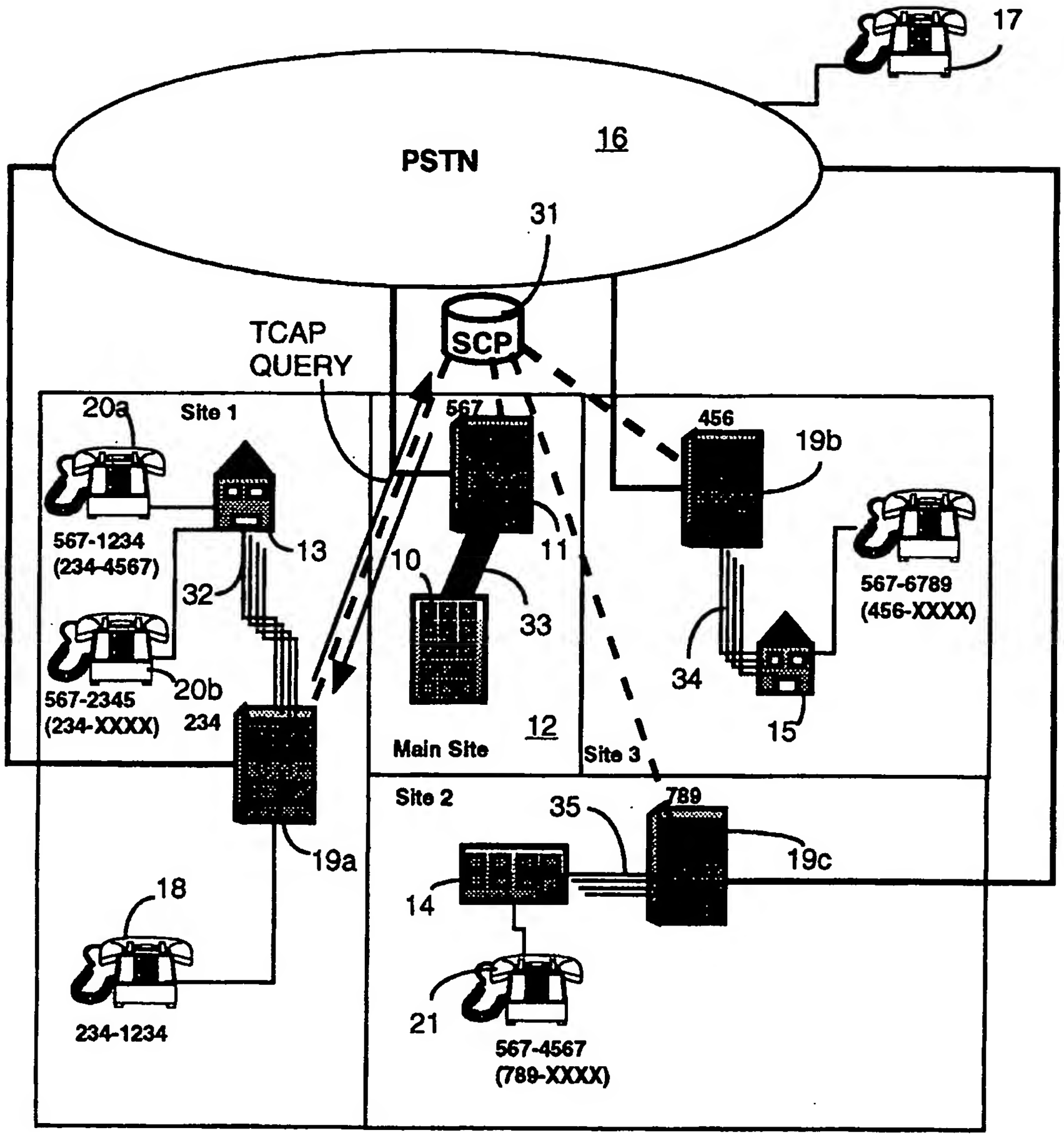

Fig. 2

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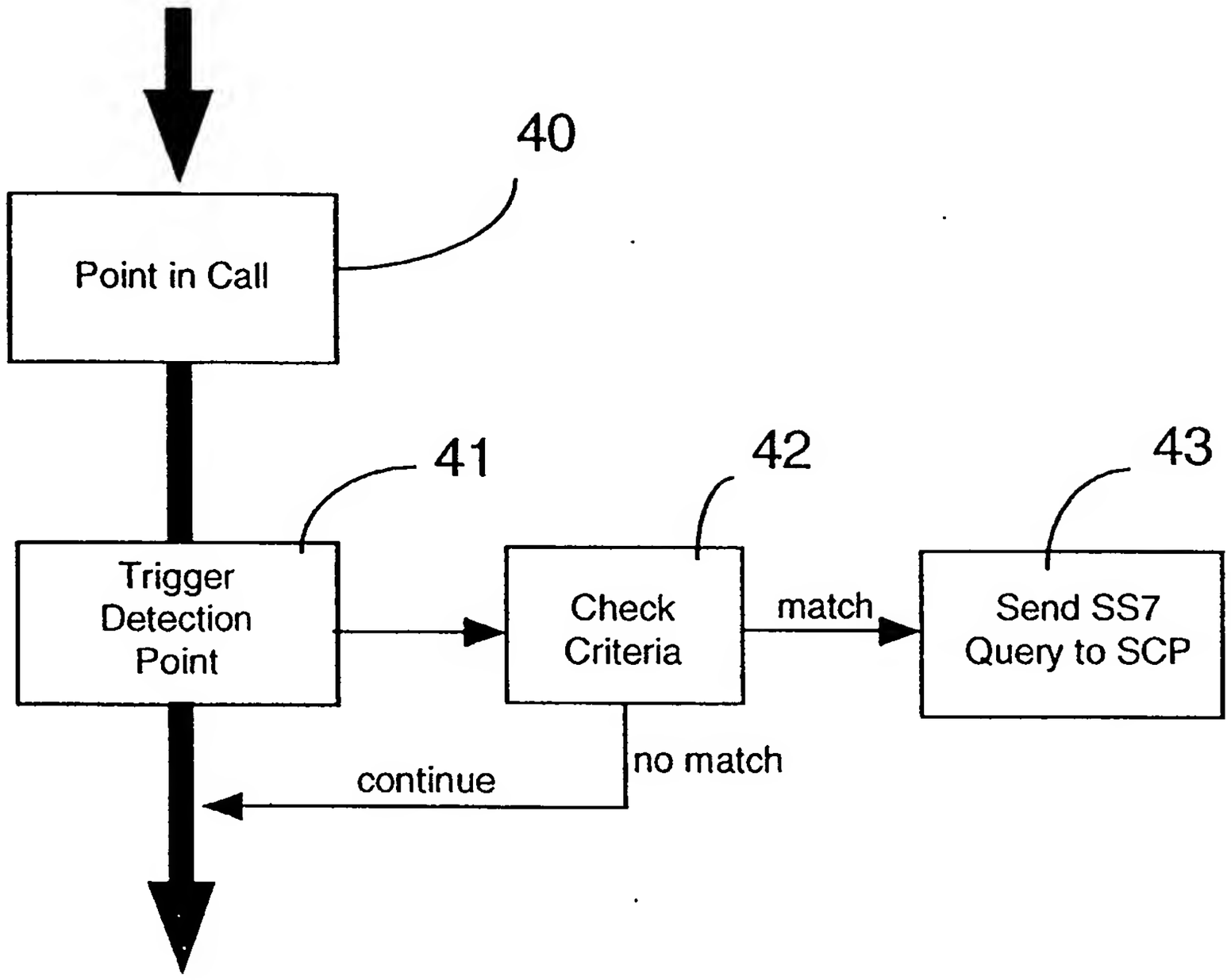

Fig. 3

Inventor: George W. Turner

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Virtual number	Real number
.	.
.	.
567-	567-
567-	234-
.	.
.	.
567-	656-
567-	789-
.	.
.	.
.	.

Fig. 4a

Real number	Virtual number
.	.
.	.
416-967-0897	002-443-0200
416-968-3241	555-435-0987
.	.
.	.
514-234-1234	001-446-5476
514-235-4567	000-567-9876
.	.
.	.
.	.

Fig. 4b

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